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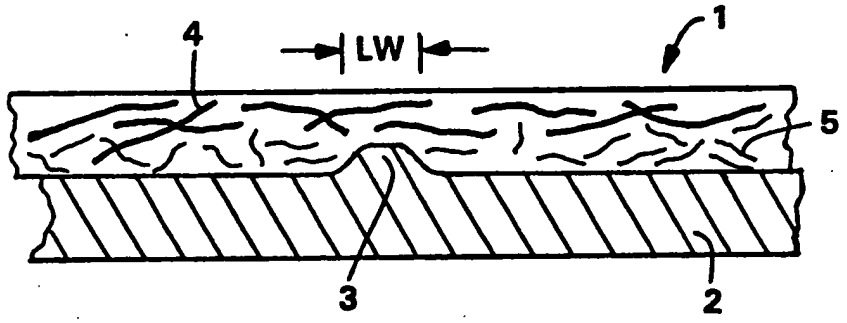
(54) Title: DECORATIVE FORMATION OF TISSUE

(57) Abstract

Paper sheets, such as tissue sheets useful for facial tissue, bath tissue and the like, are formed with a decorative pattern (3) imparted to the tissue sheet (1) by the forming fabric (2). The decorative pattern is incorporated into the forming fabric by a variety of means, such as stitching, silk screening, printing, weaving, or overlaying a fabric with a decorative pattern onto a conventional forming fabric. The presence of decoratively-shaped areas (3) in the forming fabric (2), which are areas of relatively slow water drainage, cause corresponding areas in the resulting sheet to have a translucent appearance attributable to a relatively lower basis weight and/or different fiber composition. The decorative patterns are preferably formed in the outer or surface layer(s) of the paper sheet.



DECORATIVE FORMATION OF TISSUE

Background of the Invention

Tissue products such as facial tissue, bath tissue, kitchen towels, dinner napkins and the like are often aesthetically enhanced by printing or embossing the surface of the tissue with decorative designs. Both printing and embossing are basesheet post treatments which increase operational costs and require additional capital equipment. An economical method of enhancing the aesthetic appeal of tissues which does not require additional equipment and additional web handling would be advantageous.

Summary of the Invention

It has now been discovered that tissue sheets can be provided with decorative patterns by forming the tissue sheet on a forming fabric having a decorative pattern superposed thereon or incorporated therein. As a result of the different drainage characteristics of the portions of the forming fabric having the decorative pattern, the resulting tissue sheet exhibits a subtle, yet distinctive, translucent decorative pattern corresponding to the decorative pattern of the forming fabric. More particularly, areas of the forming fabric having a more restrictive flow (or no flow) will not retain the same quantity and type of fibers as the areas of the forming fabric having a less restrictive flow. As a consequence, by using a papermaking furnish containing relatively long fibers and relatively short fibers, a decorative pattern can be imparted into the newly-formed sheet in which the decorative pattern in the tissue is delineated by areas of different fiber composition (different fiber length) corresponding to areas of differing forming fabric drainage.

Hence, in one aspect, the invention resides in a tissue sheet having a distinct decorative pattern cast into the sheet during the initial formation of the sheet on a forming fabric, said tissue sheet comprising long papermaking fibers and short papermaking fibers,

long fibers; (c) dewatering and combining the first and second embryonic webs at a consistency of from about 20 to about 50 percent; and (d) drying the combined web to form a unitary, layered, decorative tissue sheet.

In a further aspect, the invention resides in a woven papermaking forming fabric having multiple spaced-apart areas of relatively slow drainage, the shapes of which areas define visually distinct decorative patterns.

The aqueous suspension of papermaking fibers can be introduced to the decorative forming fabric in several different ways. In all cases the consistency of the aqueous fiber suspension is 5 weight percent or less, more specifically from about 0.05 to about 2 weight percent, and still more specifically about 0.2 weight percent. For example, if using a single headbox, the aqueous fiber suspension can be layered or blended (non-layered). If blended, the papermaking fibers preferably comprise at least about 50 dry weight percent short fibers and at least about 20 dry weight percent long fibers. This combination of fibers provides a large number of short fibers which flow around the decorative design areas of the fabric having impeded drainage flow rates, thereby concentrating the short fibers in the high flow rate areas of the forming fabric to form corresponding areas in the resulting paper sheet of relatively higher basis weight and opacity. At the same time, there are a sufficient number of long fibers to bridge the decorative areas of slow drainage in the forming fabric and provide sufficient continuity and strength to the resulting web, even though the basis weight in the decorative areas of the sheet is relatively low.

If a layered headbox is used to deposit a layered aqueous suspension of fibers onto the forming fabric, a short fiber layer, or a layer containing predominantly short fibers, is advantageously deposited directly onto the decorative forming fabric to enable the relatively short fibers to follow the relatively fast drainage flows without the drainage of the fabric being altered by the collection of long fibers. The remaining layer(s) have greater amounts of long fibers, or can contain predominantly long fibers or consist entirely of long fibers. Some of the longer fibers end up bridging the

of the fibers in the furnish must have a fiber length greater than the line width. If the tissue is being formed by couching together separately-formed webs or by plying together separately formed plies, then there is no restriction on the length of the fibers relative to the line width. In all cases, the common purpose is to produce a decoratively-formed tissue sheet which has sufficient strength. In the case of a blended sheet, there must be sufficient long fibers in the furnish to bridge the line width to prevent holes from being formed in the sheet. At the other extreme, namely couch forming, the decoratively-formed web can afford to have holes or weak areas because it will be combined (couched) with a conventionally-formed web that imparts the necessary strength to the combined sheet. The furnish requirements for sheets formed using a single layered headbox fall in between the two extremes. In general, suitable line widths can be from about 0.02 to about 2 millimeters, more specifically from about 0.05 to about 1.5 millimeters. In addition, it is advantageous for the orientation of the majority of the lines of the decorative pattern to be substantially oriented parallel to the cross-machine direction of the sheet. Elongated decorative indicia should be aligned more toward the cross-machine direction than the machine direction. This orientation tends to retain more of the cross-machine direction tensile strength of the sheet, which is ordinarily much weaker than the machine direction tensile strength and therefore cannot afford significant strength loss.

The products of this invention are preferably layered in a manner in which the decorative portion of the web is formed into the outer or surface layer or layers. Because of the relatively lower basis weight created in the decorative areas, such decorative layers are relatively weak compared to a layer having a uniform, higher basis weight. Hence it is advantageous to provide a subsurface layer which serves to provide more strength to the tissue sheet. To this end at least one subsurface layer preferably contains at least about 50 dry weight percent long fibers, more specifically at least about 75 dry weight percent long fibers, and still more specifically about 100 dry weight percent long fibers. As is well known in the papermaking art, softwood fibers are longer than hardwood fibers and tend to impart greater strength to the tissue sheet. Depending on

Brief Description of the Drawing

Figure 1 is a schematic sectional view of a decoratively-formed sheet in accordance with this invention, illustrating the fiber composition and basis weight characteristics when formed from a blended furnish of long and short fibers.

Figure 2 is a schematic sectional view similar to that of Figure 1, but for a sheet formed with a layered furnish.

Figure 3 is a schematic sectional view similar to that of Figures 1 and 2, but for a sheet formed by couching together a decoratively formed layer and a conventionally formed layer.

Figure 4 is a schematic flow diagram of a wet-pressing couching process for making decorative tissue sheets in accordance with this invention.

Figure 5 is a schematic flow diagram of a wet-pressing process for making decorative tissue sheets in accordance with this invention using a single, layered headbox.

Figures 6 - 31 are plan views of decorative forming fabrics and the resulting tissues in accordance with this invention.

Detailed Description of the Drawing

Referring to Figure 1, shown is a schematic sectional view of a blended paper sheet as it is formed on a decorative forming fabric in accordance with this invention, illustrating the difference in fiber composition and basis weight in the decorative areas of the sheet and the fabric. Shown is the wet sheet 1 supported by the decorative forming fabric 2. A cross-section of a decorative line which forms part of the decorative indicia on the forming fabric is represented by fabric protrusion 3, which schematically represents the cross-sectional area or zone through which drainage of the water is impeded relative to the remaining area of the forming fabric shown. The width of the line is indicated by the dimension "LW". As described earlier, means for impeding or retarding the drainage rate can be in the form of additional filaments on top of or within the forming fabric weave pattern, or it can be in the form of a film or a coating which blocks or fills void space within the fabric through which water could otherwise drain. It is not necessary that the decorative line actually protrude from the surface of the fabric as shown. For

A second headbox 20 deposits a second aqueous suspension of papermaking fibers having a consistency of about 0.2 weight percent onto an endless forming fabric 21 to form a second wet embryonic web. Suitable forming fabrics for forming fabric 21 include single layer fabrics such as Appleton Wire 84M, double layer fabrics such as the Asten 856, and triple layer fabrics such as the Lindsay 3070. Either the first or second forming fabric can be the decorative forming fabric.

After initial formation of the first and second wet webs, the two webs are brought together in contacting relationship (couched) while at a consistency of from about 10 to about 30 percent. Whatever consistency is selected, it is preferable that the consistencies of the two wet webs be substantially the same. Couching is achieved by bringing the first wet web into contact with the second wet web at vacuum suction box 30, after which time the first forming fabric 13 is peeled away at turning roll 31.

After the two webs have been couched together to form a consolidated web 32, the consolidated or couched web is transferred to a papermaking felt 24 with the aid of vacuum box 18. Dewatering, drying and creping of the consolidated web is achieved in the conventional manner. More specifically, the couched web is further dewatered and transferred to a Yankee dryer 40 using a pressure roll 41, which serves to express water from the web, which is absorbed by the felt, and causes the web to adhere to the surface of the Yankee. The web is then dried, creped and wound into a roll 42 for subsequent converting into the final creped product.

Figure 5 illustrates another embodiment of this invention in which a wet-pressed tissue sheet is formed with a single, layered headbox in a forming configuration known as a crescent former. Shown is a headbox 11 from which an aqueous suspension of papermaking fibers at a consistency of about 0.2 weight percent is deposited between an endless papermaking felt 12 and an endless decorative forming fabric 13 to form a wet embryonic web. Both fabrics partially wrap a forming roll 15 such that the wet embryonic web is partially dewatered by flinging water through the forming fabric 13 due to centrifugal force and by the water absorbing properties of the

second layer made up of a continuous network of long fibers for strength. The decorative pattern of the butterfly in the finished web was the result of a basis weight and fiber composition difference in the area of the butterfly design versus the remaining area of the web. The butterfly design consisted of a low basis weight and contained only long fibers from the strength layer. The remaining areas of the sheet were of higher basis weight and contained long fibers from the strength layer and short fibers from the decorative layer.

Example 3. A couch-formed decorative tissue product was produced as illustrated in Figure 4. Specifically, 100 percent eucalyptus pulp was hydropulped at 4 percent consistency. The fiber was pumped to the stock chest and diluted to 1 percent consistency and 2 pounds per ton Berocel 596 debonder was added. This stock chest provided the fiber for the decorative sheet on the top former. The fiber from the stock chest was pumped to the forming flow spreader and formed on the fabric at approximately 0.1 percent consistency. The forming fabric for the top former was an Appleton Wire 94M silk screened with a latex resin with the butterfly pattern shown in Figure 9. The line width sealing the fabric to produce the butterfly design was approximately 1 mm. wide. The butterfly design was silk screened onto the fabric with the same process that designs are silk screened to clothing. A stencil of the pattern was produced, placed on top of the fabric and latex resin was forced through the stencil and embedded into the fabric to seal and restrict the drainage of the fabric in the area of the pattern. The viscosity of the resin must be fluid enough to enter the fabric but not so viscous as to migrate freely through the fabric and not retain the crisp pattern image.

The bottom former also had an Appleton Wire 94M forming fabric with no pattern. 100 percent northern softwood kraft pulp was hydropulped at 4 percent consistency. The fiber was refined in a single disk refiner between 3 percent and 4 percent consistency at a gap of 0.003 inch. The fiber was then pumped to a second stock chest and diluted to 1 percent consistency. The fiber from the second stock chest provided fiber for the bottom former and again the fiber

components of the pattern and the rest of the base sheet controlled by the drainage of the fabric. The line width of the sealed components of the butterfly pattern was approximately 1 millimeter. The fiber length distribution of the northern softwood kraft furnish, as tested by the Kajaani Fiber Analyzer, showed that 50 percent of the fibers are longer than 1 millimeter. The Kajaani Fiber Analyzer showed that 94 percent of the eucalyptus furnish was shorter than 1 millimeter. The base sheet in this example was 50 percent northern softwood kraft, indicating that approximately 25 percent of the total number of fibers in the base sheet were longer than 1 millimeter and were capable of spanning the sealed line component of the pattern during the drainage process and retaining a continuum of fiber network to carry the strength of the sheet. Almost the entire eucalyptus furnish is shorter than the 1 millimeter line width and cannot span the sealed line of the pattern in the fabric. Also the drainage rate and flow through the fabric carried the shorter eucalyptus fiber away from the sealed line of the pattern and the fiber collected in the open drainage areas of the fabric. This resulted in a basis weight and fiber composition difference between the sealed line components of the pattern and the remaining areas of the sheet.

Example 5. When using the couch forming process, the decorative pattern can be enhanced by placing cationic dyes in the different layers of the sheet. Three combinations of dye were tried using the process described in Example 3: (1) the decorative eucalyptus layer was colored blue and the strength layer was not dyed; (2) the decorative eucalyptus layer was not dyed and the strength layer was colored blue; and (3) both layers were colored blue but the strength layer had twice the concentration of dye of the decorative layer. All three combinations enhanced the visual perception of the pattern, with the last combination of both layers colored at different concentrations having the greatest pattern perception. Figure 12 is a photograph of a tissue having no dye. Figure 13 is a photograph of a tissue having dye in both layers with a greater concentration of dye in the strength layer.

Example 6. The decorative formed sheet having dyes of different concentration in the two layers described in Example 5 was

stock chest provided fiber for the top former. The fiber from the stock chest was pumped to the forming flow spreader and formed on the fabric at approximately 0.1 percent consistency. The forming fabric for the top former was an Appleton Wire 94M.

100 percent eucalyptus pulp was hydropulped at 4 percent consistency for 15 minutes. The fiber was pumped to the stock chest and diluted to 1 percent consistency. The forming fabric for the bottom former was an Appleton Wire 94M with five different decorative patterns. The patterns consisted of (1) A wild rose pattern that was stitched or embroidered on the forming fabric. The wild rose pattern is shown in Figure 19; (2) An overall floral pattern that consisted of a large piece (approximately 15 inches x 36 inches) of lacy fabric that was sewn onto the forming fabric. The overall floral pattern is shown in Figure 20; (3) A line floral pattern that consisted of a large piece (approximately 15 inches x 36 inches) of lacy fabric that was sewn onto the forming fabric. The overall line floral pattern is shown in Figure 21; (4) A small floral pattern that was stitched or embroidered on the forming fabric. The small floral pattern is shown in Figure 22; (5) A dot pattern that consisted of a large piece (approximately 15 inches x 36 inches) of lacy fabric that was sewn onto the forming fabric. The dot pattern is shown in Figure 23.

A 3.8 grams per square meter dryer basis weight sheet of 100 percent northern softwood kraft was formed on the top former and vacuum dewatered to approximately 10 percent consistency. An 8.9 grams per square meter dryer basis weight sheet of 100 percent eucalyptus was formed on the bottom former and vacuum dewatered to approximately 10 percent consistency. The sheet from the top former was then transferred to the sheet and fabric of the bottom former to produce a single web of 12.7 grams per square meter total dryer basis weight. The web was vacuum transferred to an Albany Duramesh felt and carried to the Yankee dryer. The web was wet pressed and transferred by a pressure roll to the Yankee dryer. The web was dried to approximately 90 to 95 percent consistency and creped. This machine configuration results in the sheet from the top former located against the felt and on the air side of the dryer during creping. The bottom former (decorative sheet) was located on the air side of the felt and was against the Yankee dryer during creping.

lily floral pattern. Figure 31 is a photograph of the same tissue sheet at 10x magnification using transmitted light to illustrate the basis weight and fiber composition difference between the decorative areas of the lily and the adjacent background area of the tissue.

Example 10.

A decoratively-formed tissue was formed as illustrated in Figure 5. This forming configuration is commonly referred to as a crescent former. More specifically, 100 percent northern softwood kraft pulp was disintegrated with a hydropulper at 2 percent consistency for 25 minutes. The fiber was pumped to the stock chest and diluted to 1.14 percent consistency. This stock chest provided fiber for the upper layer of the layered headbox.

100 percent eucalyptus pulp was disintegrated with a hydropulper at 4 percent consistency for 25 minutes. The fiber was pumped to the stock chest and diluted to 2.4 percent consistency. This stock provided fiber for the bottom layer of the layered headbox. The forming fabric was an Appleton Wire 94M silk screened with a lily floral pattern shown in Figure 29.

The bottom layer of the tissue consisted of 100 percent eucalyptus and had a 4.88 grams per square meter dryer basis weight. The top layer of the tissue consisted of 100 percent northern softwood kraft and had a 7.32 grams per square meter dryer basis weight to produce a single web of 12.2 grams per square meter total dryer basis weight. The web was vacuum transferred to an Albany Duramesh felt and carried to the Yankee dryer. The web was dried to approximately 90 to 95 percent consistency and creped. The resulting sheet had 1179 grams MD-Dry tensile with 30.6 percent stretch and 608 grams CD-Dry tensile with 7.0 percent stretch. Machine speed for this example was 2500 feet per minute.

It will be appreciated that the foregoing description and examples, given for purposes of illustration, are not to be construed as limiting the scope of this invention, which is defined by the following claims and all equivalents thereto.

continuum of relatively high basis weight and wherein said second layer is of substantially uniform basis weight.

8. A method of forming a tissue sheet comprising depositing an aqueous suspension of short fibers and long fibers onto a decorative forming fabric which contains areas of relatively slow drainage, the shapes of which areas define distinct decorative designs, wherein the forming fabric retains the fibers of the aqueous suspension of fibers as the water passes through the forming fabric, and wherein the long fibers are preferentially retained on the surface of the forming fabric in the decorative areas of relatively slow drainage.

9. The method of Claim 8 wherein the aqueous suspension of short fibers and long fibers is a blended suspension.

10. The method of Claim 9 wherein the aqueous suspension contains at least about 50 dry weight percent hardwood fibers and at least about 20 dry weight percent softwood fibers.

11. The method of Claim 8 wherein the aqueous suspension of short fibers and long fibers is a layered suspension comprising first and second layers, said first layer containing at least 50 dry weight percent hardwood fibers, wherein said first layer is deposited in direct contact with the decorative forming fabric.

12. A method of making a tissue sheet comprising: (a) depositing a first aqueous suspension of papermaking fibers having a consistency of less than 5 weight percent onto a decorative forming fabric to form a first embryonic web, said first suspension of papermaking fibers containing at least about 50 dry weight percent short fibers; (b) depositing a second aqueous suspension of papermaking fibers having a consistency of less than 5 weight percent onto a forming fabric having a uniform appearance to form a second embryonic web, said second suspension of papermaking fibers containing at least about 50 dry weight percent long fibers; (c) dewatering and combining the

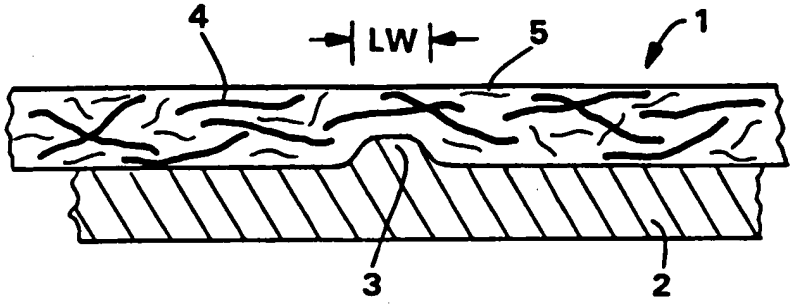


FIG. 1

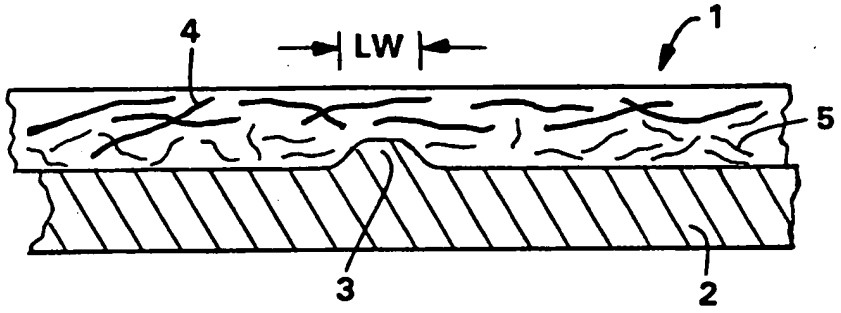


FIG. 2

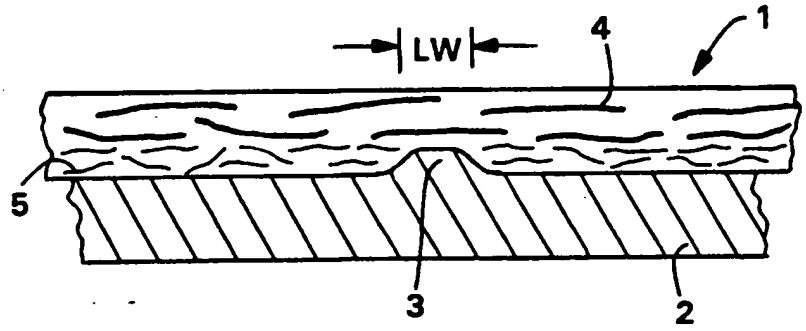


FIG. 3

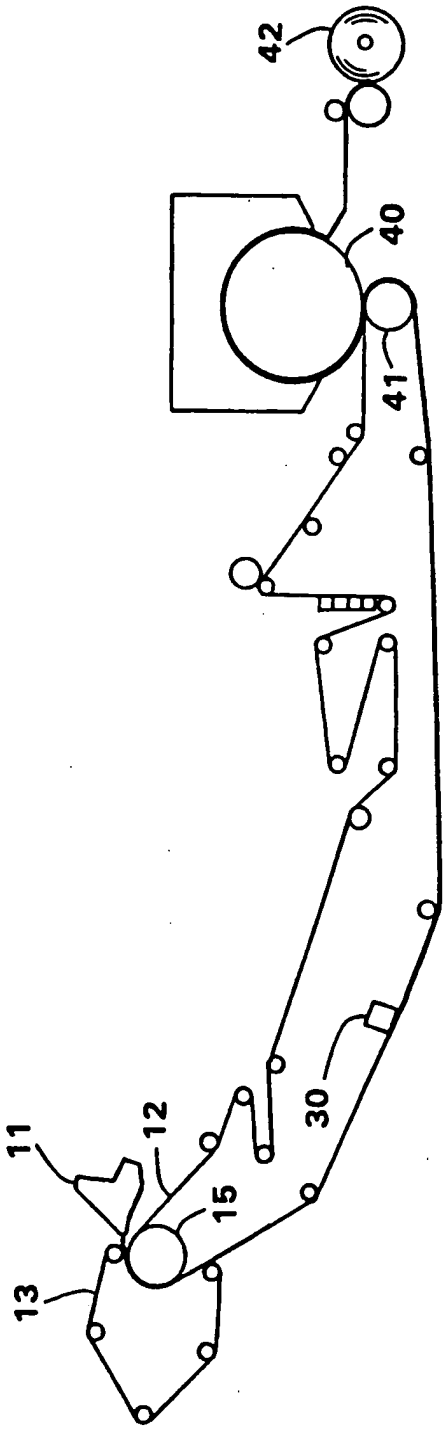


FIG. 5

FIG. 8

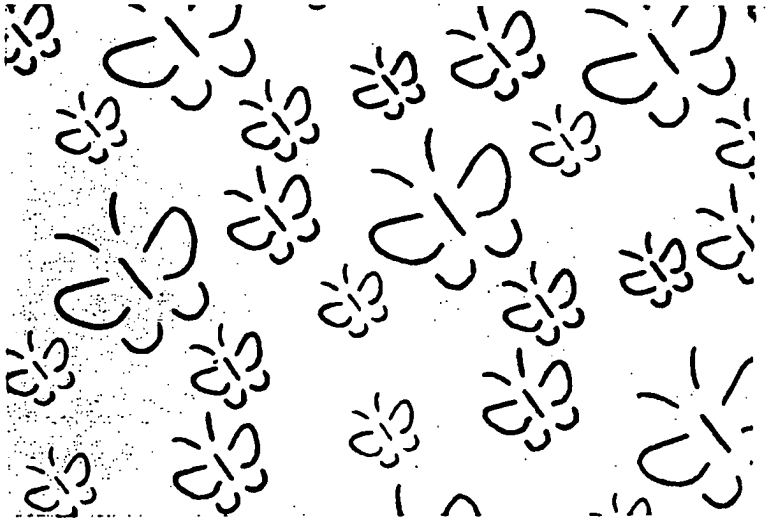


FIG. 9

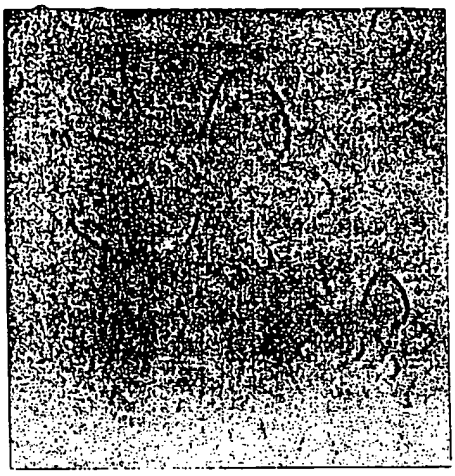


FIG. 12

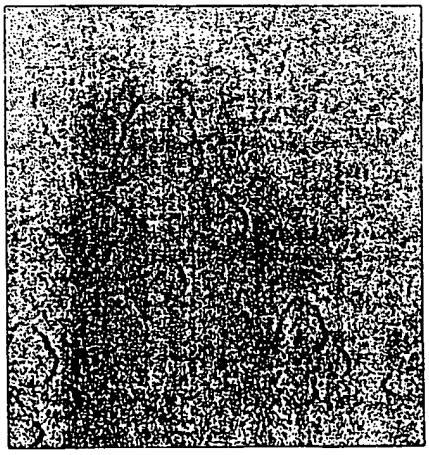


FIG. 13

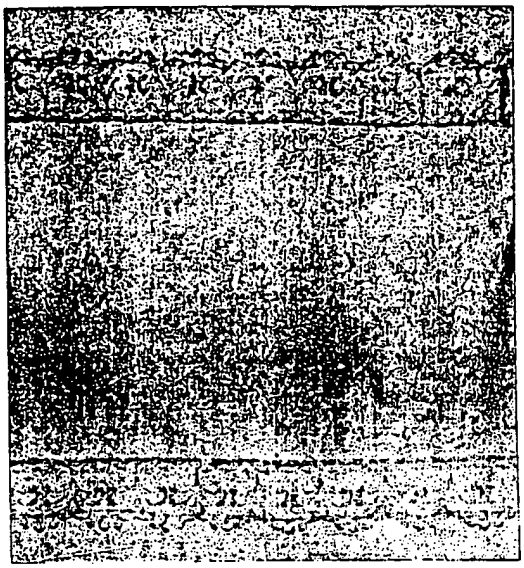


FIG. 16

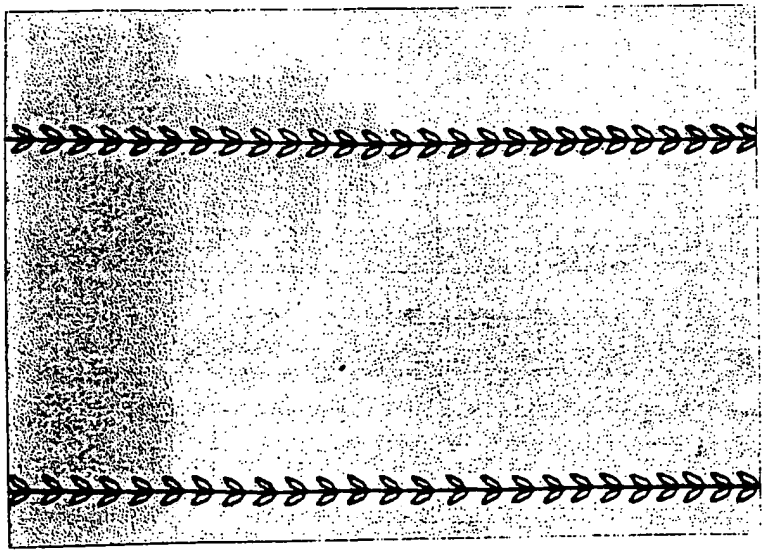


FIG. 17

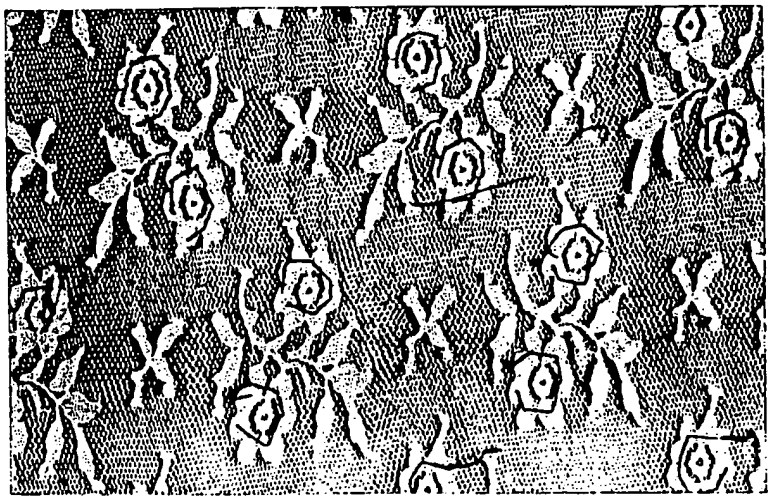


FIG. 20

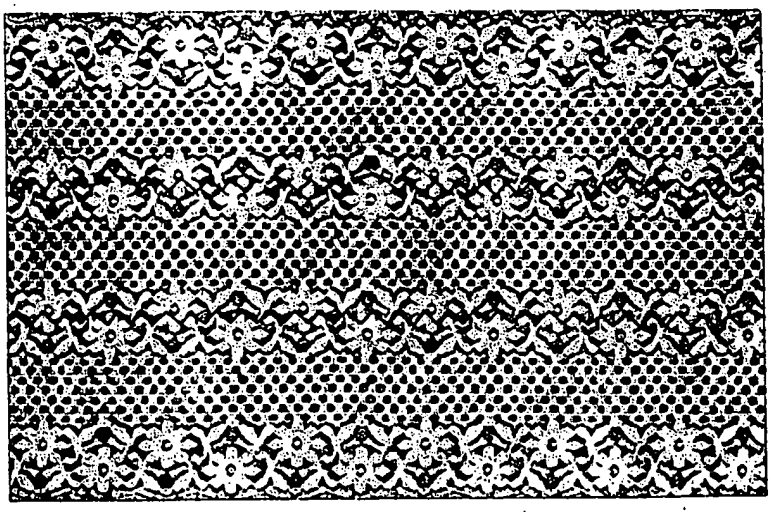


FIG. 21

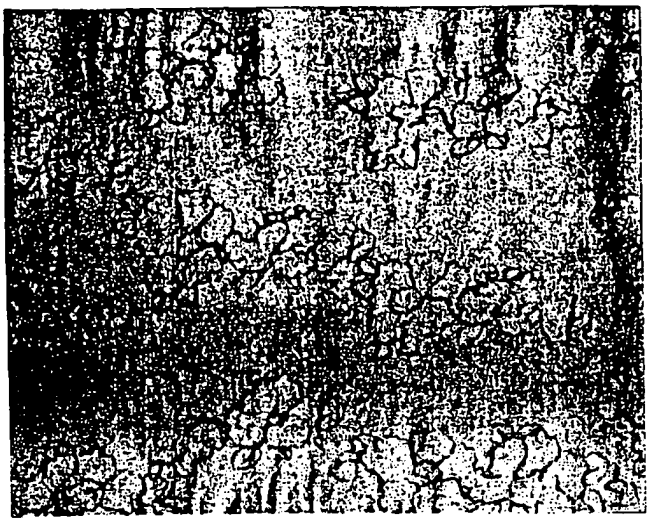


FIG. 24

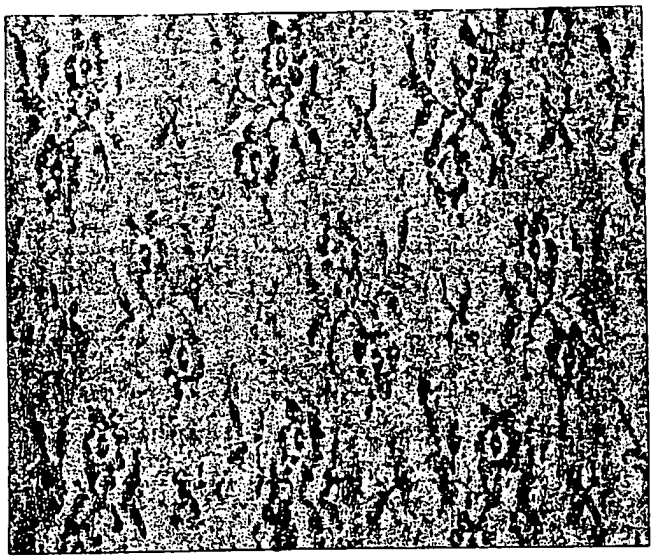


FIG. 25

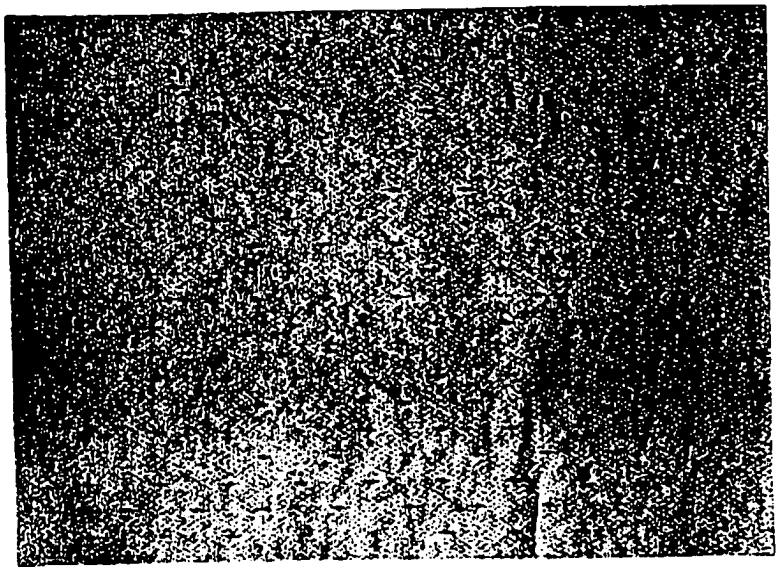


FIG. 28

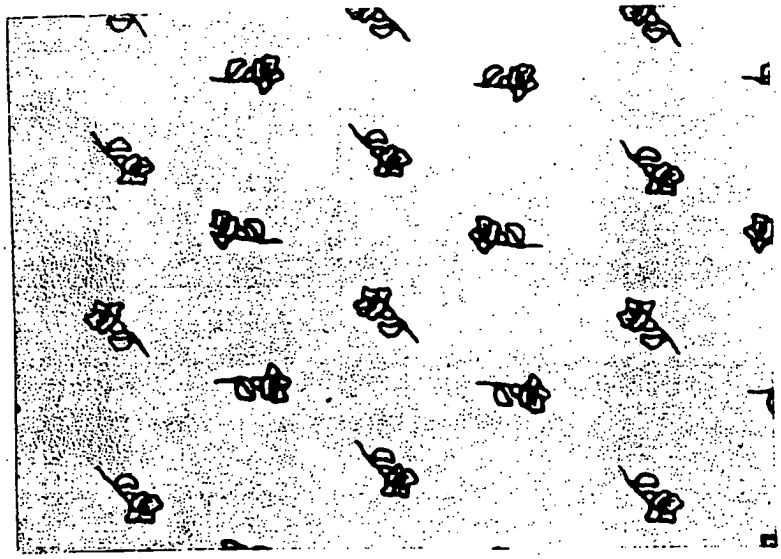


FIG. 29

INTERNATIONAL SEARCH REPORT

Int. onal Application No
PCT/US 96/05862

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21F11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	GB,A,1 008 703 (JAMES R. CROMPTON AND BROTHERS LTD) 3 November 1965 see page 1, line 79 - page 2, line 74; figures 1-4 see page 3, line 13 - line 35; figure 5	1-4,6-8, 13-15,19 5,11,12, 16
X	DE,A,14 61 082 (DEXTER CORP.) 28 November 1968 see page 17, paragraph 2 - page 19, paragraph 1; figures 10-14	1,8,9, 13,16
A	GB,A,1 117 731 (WYCOMBE MARSH PAPER MILLS LTD) 26 June 1968 see page 2, line 54 - line 86; figure	4,7,11, 12
A	US,A,1 687 140 (A. PLEYER) 9 October 1928	

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
13 August 1996	09. 09. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Schmitt, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 96/05862

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